IPP Technical Evaluation
Final Report

US Partner:	**South Carolina Research & Education Foundation (SCUREF)**
NIS Partner:	**Institute for the Biology of Inland Waters (IBIW), Russian Academy of Sciences**
Location of site visit:	**IBIW facilities, Borok, Yaroslavl region**
Date of visit:	**October 7-9, 1996**
Date report submitted to IREX:	**October 25, 1996**

The following technical evaluation is based on the review of briefing materials provided in the binder by IREX, a site visit to Borok on October 7-9, 1996, and the review of the draft marketing paper prepared by Dr. Hammig at SCUREF. During the site visit, the evaluator was shown the experimental fish-raising tank system in the basement of the Ichthyology Laboratory building and in the IBIW fish-raising pond facility. The cages used for growing fish in the Rybinsk reservoir during the summer have already been removed and disassembled. The evaluator was shown the drawings of the proposed cage design developed by Yuri Gerasimov and his US colleagues, and similar types of cages stored at the IBIW pond facility. The evaluator met with A. I. Kopylov, the acting Director of IBIW and the Russian Project manager and Co-Principal Investigator; and V.V. Khalko, I. A. Grechanov, and Y. Gerasimov. Other project staff members had already left for the US to continue their education and training at SCUREF and to participate in the SETAC (Society of Environmental Toxicology and Chemistry) Conference.

A. Discuss the strongest and weakest aspects of technical and professional work being done by this partnership.

The project staff includes highly qualified Russian and US scientists. Most of the Russian project participants have the Russian equivalent of Ph.D. degrees (Candidate of Science) in their field. The results of their work are subject to rigorous scientific community peer reviews through paper publications, conference presentations (the most recent one at the SETAC conference), and presentations at Ascience-to-practice@ exhibitions. These reviews ensure the high professionalism and technical quality of their work.

Recommendations for Improvement: none.

B. What do Russian partners see as the Acriteria for success@ for their partnership project activities? How close are they to attaining them?

Conceptually, the project consists of two parts: first, the development of aquaculture and second, training in economics, consulting, and toxicology.

For the aquaculture part of the project, the Acriteria for success@ is the development of their fish-raising tank system beyond the experimental stage, creation of a full-scale fish production system, and establishment of IBIW as a regional and national aquaculture consulting center.

The currently operating fish-raising system is experimental and has the capacity to raise up to 100 kg of 50 gram carp fingerlings, which produces about 1,000 kg of commercial fish. The Russian partners have the designs and know-how to launch a full-scale fish-raising system, but whether or not it is implemented will depend on the availability of financing.

According to Dr. Kopylov, IBIW is already providing consulting services to parties interested in raising fish, both inside and outside the Yaroslavl region. This includes providing project feasibility assessments and the expertise required for such projects. For example, recently I. A. Grechanov provided consultations on fish raising to Republic Komi, a gas company in Ukhta. At the time of the site visit, the IBIW staff was preparing to present information on the fish-raising system at the Russian Academy of Sciences exhibition of scientific developments for industry.

Currently, all training activities are carried out in the US. The interviewed Russian participants were satisfied with their quality and content.

C. Technical merit and appropriateness of program components.

1. Training.

The Russian partners presently do not provide any training within the IPP project framework**.**

The training program at SCUREF has several dimensions. Two Russian trainees, Flerov and Rusinov, are trained in economics and management, which will be particularly beneficial for IBIW in its transition to self-sustainability. The success of a free-market enterprise depends not only on the quality of its products and services, but to a great extent on its ability to provide these products and services in an economically efficient manner. This requires special management and marketing staff. In a planned economy with government funding of scientific research institutions like IBIW, there was no need for marketing specialists. The lack of these types of specialists made it more difficult for research institutions to integrate into a developing market economy, despite the high professionalism of their staff. Consequently, IBIW should benefit considerably from this component of the training program.

The other trainees are mid-level scientists. According to Yuri Gerasimov and the project briefing materials, these trainees primarily carry out professional research work within their fields of interest. Gerasimov was working at the aquaculture complex at Clemson. As part of his work, he participated in creating and operating a fish-raising tank system similar to the one in Borok, as well as operating similar systems using different setups and equipment for water treatment. This allowed him to gain the necessary experience to continue working in Borok to further improve the IBIW fish-raising tank system.

A primary skill being learned by Komov is understanding *Dreissena* (zebra mussel) life history dynamics and controls. This is a problem both in the US and Russia and could lead to future cooperative studies. During the summer joint field works in Russia, *Dreissena* were found in some of IBIW's Sunoga facility ponds and in Lake Pleshcheevo in Pereslavl.

A primary skill being learned by Chuko is the analysis of organic contaminants (such as PCBs, dioxins, pesticides, etc.) by means of gas chromatography (GC) and high-pressure-liquid-chromatography (HPLC). These organic contaminants are a high priority for the Rybinsk reservoir. At present, IBIW does not have equipment for their analysis and order the analysis of collected samples for these contaminants from the Hydrochemical Institute in Rostov. GC and HPLC equipment is very expensive, and IBIW will be unable to purchase it in the foreseeable future. It is definitely beneficial for IBIW to have a specialist with a sound understanding of these analytical techniques because this allows them to improve the quality of sample collections and preservation and analytical data interpretation. It is advisable that the focus of Komov's work be broadened, e.g., by incorporating other aspects of organic contaminant toxicology.

Another important aspect of the training program is the networking opportunities it provides for its mid- and high-level participants through a series of meetings with representatives of different consulting, industrial, and aquaculture companies.

Recommendations for Improvement:
In general, the content of the training program for project participants at SCUREF is beneficial in achieving the partnership goal. The only recommendation is to broaden the scope of Komov's training program to incorporate some other aspects of organic contaminant toxicology, in addition to chromatographic analysis.

2. Products.

The specific products reviewed for this partnership were the marketing paper, fish-raising tank systems, and cages in the reservoir.

2.1. Marketing paper.

The draft of the marketing paper for aquaculture and IBIW consulting services was prepared by Dr. Michael Hammig, J. Flerov, and A. Rusinov at Clemson University, and is subject to further refinement.

The plan specifies services IBIW can provide to different clients. IBIW plans to prepare separate specific marketing plans for each of the marketable goods or services. A strong point of the plan is that it provides for the creation of a database of potential customers, competitors, and collaborators, which will give IBIW strong knowledge of the market.

There is a more detailed marketing plan for aquaculture. It specifies the objectives of aquaculture system development, services and products, types of potential customers, possible client search strategies, possible implementation schemes, and the time table for project implementation.

The present first draft of the marketing plan is very general. It provides a good conceptual basis for further development and realization. Special attention should be given to issues of budgeting and plan implementation. Obviously these issues cannot be completely addressed in the US, so the plan should be further refined when Russian trainees return to Borok. It would considerably increase the efficiency of the work if the project participants in Russia were involved in marketing plan preparation, as they have a better hold of the situation in the country and region.

2.2. Fish-raising tank system.

The evaluator was shown the experimental fish-raising tank system installed in the basement of the Ichthyology Laboratory building in Borok and the pictures of the fish-raising tank systems used in SCUREF. The principal scheme of the IBIW system is shown in figures 1 and 2, attached.

The system consists of two production lines. Each line includes a fish rearing tank, a settling tank, and a biofiltration tank. Both lines use the same heating tank. Water circulates in the system and the water lost through evaporation is replaced by water from upstairs tanks. In the heating tank, clean water is heated to 25^{o}C using electric heaters and is then pumped by electric pumps into fish rearing tanks. Water quality in the fish rearing tanks is regularly monitored for dissolved oxygen and ammonia content. From the fish rearing tanks, the water polluted with fish excrement flows into the settling tanks, where suspended solid particles fall out of the water column by gravity, and then to the biofiltration tank, where bacteria remove nutrients and organic matter. Currently, Y. Gerasimov is planning to install a trickling biofilter, which will allow them to achieve a higher biotreatment efficiency. After the biofiltration water enters into the heating tank, the cycle repeats again.

This year, this experimental system was used to rear carp. Carp fry obtained in lab conditions from artificially collected carp eggs and sperm were put in the tanks in January and February and were kept there for four months. During this time, the fry grew into 50-80 gram fingerlings which were then placed into cages in the reservoir and into ponds at the IBIW pond facility. During the four summer months, the carp in the reservoir cages grew to 400 grams, which is a market-size fish. The carp placed in the ponds grew to 200 grams, and it was decided to keep them in the ponds over the winter, so that next season they can grow to 700-800 grams or more. Alternatively, fingerlings can be left in the tank system to grow to market size. The use of the production scheme, including the fish-raising tank system, allows them to obtain commercial-size carp in 8 months, compared to 2-3 years in the cases of the traditional open pond system (Kozlov V. I., Abramovich L.S., 1980).

This result was achieved by creating optimal conditions for fish growth in the tank system. The fish growth rate is proportional to the intensity of feeding and the efficiency of food conversion. Carp is a thermophilic fish. The maximum feeding intensity and thus the maximum growth rate of carp is observed at the water temperature of 23-29^{o}C. At the water temperature of 15-17^{o}C, the intensity of feeding decreases 3-4 times. At 4 ^{o}C, carp stop feeding and thus growing and survives at the expense of previously accumulated tissue (Moiseev P.A. *et al*, 1975). In the tank system, the temperature is maintained at 25 ^{o}C, which is within the maximum growth rate temperature range. This ensures that the fish are constantly growing at a maximum rate, which minimizes their period of growth to commercial size.

The fish in the tank system are raised in a controlled environment. The water quality in the system is monitored and maintained. The fish are fed artificial feed, the chemical content of which is known and can be controlled. This ensures that the raised fish are contaminant-free.

2.3. Reservoir cages.

In May, part of the carp fingerlings were placed in 3 cages in the Rybinsk reservoir. The cage has a cubic shape with the side size of 1.3 m and is made of a metal frame covered with a mesh net small enough to contain fish inside. 300 carp fingerlings were placed in each cage.

Initially, it was planned that the cages would be placed in contaminated and clean areas of the Rybinsk reservoir to compare the contaminant concentrations in the fish grown in different areas. Due to the extremely low reservoir level this year (3-4 meters below the average level) this plan turned out to be unfeasible. As a result, all cages were placed at one site near the town of Volga in the mainstream of the Volga river. The cages were operated by Sergei Pavlov, a businessman from Yaroslavl who is cooperating with IBIW and who also has trade operations and a small wood-processing and furniture factory. During the summer period, the caged carp grew to a size of 400 grams. After the cages were harvested, several carp were taken for contaminant content analysis. This analysis is performed at the SCUREF lab facilities. At the time of this site visit, the analysis results were not yet available at IBIW.

The contamination of fish occurs mostly as a result of biomagnification in the food chain when fish consume contaminated plankton and benthic organisms. Benthic organisms, which are in contact with contaminated bottom sediments, may have high levels of pollutants. Grown carp fingerlings feed mostly on benthic organisms (Moiseev P.A. *et al,* 1975), from which carp can accumulate contaminants.

The construction of the reservoir cages used in the project ensures that the fish have no contact with bottom sediments and eat only artificial feed. The contaminant content of the feed can be controlled. This allows fish to be raised with a contaminant content well below the maximum permissible levels.

The same applies to raising fish in ponds. In this case, there is also water quality control, which helps to raise contaminant-free fish.

21. Further development of aquaculture system.

The present fish-raising tank system is experimental. According to Yuri Gerasimov, its capacity is 100 kg of 50-gram carp fingerlings, from which about 1,000 kg of market-size fish can be grown. By increasing the efficiency of water treatment in the system, more fish can be grown at one time and the system capacity can be increased to 7,000-8,000 kg of commercial fish. IBIW has the design of a full-scale tank system requiring a 20 x 40 m area. This system will have the capacity of producing 60 tons of commercial carp. The considerable advantage of the IBIW system design is that it is technically simple, but efficient, and can be built and maintained at a lower cost than its tech analogs.

The partnership's ideas on how to expand its aquaculture operation are partially represented in the marketing plan. This includes establishing cooperation with local fish brigades, which during the summer could raise the fingerlings grown during the winter in the tank system. There is also the idea of creating some kind of aquaculture Aconsortium,@ which would include IBIW, the producer of fingerlings, the fish operators raising fish in cages, and the feed manufacturer, on the basis of a product-sharing agreement.

The principal element of the system is the use of warm water. The energy consumption for water heating can negatively affect the economic viability of the aquaculture system. Initially, the IBIW system was designed with the idea that it would be used by enterprises with considerable amounts of waste heat, e.g. nuclear power plants, cement manufacturing, etc. Currently, IBIW continues to pursue this idea. Some new developments in this direction may result from presenting information about the fish-raising tank system at the RAS Ascience-to-practice@ conference.

Recommendations for Improvement:

The establishment of the effective aquaculture system requires expertise in management and finance, including obtaining initial investment capital, and a considerable time commitment. The local businessman who worked with the partnership this year has demonstrated interest and commitment to the project, but for the moment does not have enough free capital to invest into the project. Possible sources of business expertise for the aquaculture project could be Citizens Democracy Corps and the US-Russia Business Collaboration Center, which bring senior US volunteer advisors for one to two months to work directly with small and medium sized Russian enterprises. This organization can be reached by fax at 7-095-931-9663 or by e-mail at jlyons@cbi.co.ru for more information on their program.

1. Resource and Learning Centers.

There are no Resource Centers to evaluate for this partnership.

1. Consulting Services.

Due to its high expertise in different aspects of water ecosystems, IBIW is capable of providing high quality consulting services in this field. In the 1980s, the data collected by IBIW staff served as major and decisive evidence in the court case on water contamination brought by local environmental protection authorities in the Vologodskaya oblast against the Cherepovets metallurgical enterprise, which resulted in the enterprise's conviction and payment of a considerable fine. At present, IBIW has an ongoing project of water ecosystem assessment in the Rybinsk reservoir as part of a contract with the Vologodskaya oblast authorities.

This year the US partners were involved in the project of water ecosystem evaluation and monitoring of Lake Pleshcheevo under a contract with the ASlavich@ enterprise in Pereslavl. This is the biggest contract IBIW has at present. The contract extends for a five-year period until the year 2001. Under this contract, every month a team of 15-20 scientists conducts a survey of the lake ecosystem to assess whether or not there is any effect of the Slavich effluents.

IBIW has obtained a license to carry out environmental and ecological works. It is planning to obtain the certification of its analytical equipment so that the analytical results can be officially used. This can create an additional source of revenue for the IBIW, as it will be able to perform commercial analytical works for agricultural and food manufacturers and some other consumer goods manufacturers. The IBIW has a brochure in Russian and English describing its research and consulting capabilities.

Recommendations for Improvement:

The existing information brochure was made as part of the IPP project. The Russian trainees at Clemson, according to the briefing materials, are preparing the brochure on the consulting capabilities of IBIW for western and US institutions. A similar market-oriented brochure should be prepared for the Russian market as well. It should put forward IBIW's consulting services and include information on some consulting projects, both completed and in progress, and major IBIW scientists.

Besides Russian environmental authorities and enterprises, IBIW could provide services to foreign consulting companies with projects in Russia. It is a common practice at present for foreign consultants to get contracts in the NIS from USAID and the World Bank and to use Russian subcontractors to carry out the work. Information on these consulting companies and ongoing and prospective projects can be obtained from USAID and World Bank Moscow offices.

A. What additional technical assistance the Russian side could use to improve their work in general?

The IBIW has highly qualified staff and good equipment to support its work. Because the institute is located in a rural area, however, its access to information, including information on possible clients and contracts, is restricted. IBIW would benefit a lot from reliable access to modern information systems such as the Internet. At present, IBIW is connected to e-mail, but it operates only from one workstation, which considerably decreases the efficiency of its use. Creating a computer network at the IBIW facilities with a connection to the Internet and e-mail would considerably enhance the work of the institute.

A. New directions and possible contacts.

The project has established three major directions in its development: aquaculture system development, consulting services, and tourism. These directions are broad and allow the project to use the existing IBIW capabilities to their full extent. The Partnership is planning to continue to develop in all of these directions and to broaden the network of its clients and cooperators in each direction. For example, the project led to plans for ecotourism development in cooperation with a US company, Global Connection. The IBIW also recently started working with tourist organizations from Yaroslavl oblast to establish a new tourist program which would include several day visits to Borok and its surroundings.

One possible additional direction of further development could include growing different types of algae. Algae is used for manufacturing different types of nutritional supplements for humans and agricultural animals, medicines, biosorbents, etc. At present, there are several companies in Russia that are engaged in the commercial growing and processing of algae, and there is a demand for algae products. Algae is grown in tank systems and has a growth period that is much shorter than that of fish, so it may turn out to be a viable option for IBIW. Additional information can be obtained in the Laboratory of Alternative Energy Sources at Moscow State University.

A. Partnership sustainability plan assessment.

The main idea of the project is that revenue from the aquaculture efforts will provide a revenue source for the IBIW until the Russian market for environmental consulting services develops. The partnership can expect to earn revenue from fish sales next year when the carp that were left in the ponds this year grow to commercial size and a new lot of carp raised in the tank system during the winter is grown in cages or ponds. The IBIW is planning to purchase two big ponds near Borok and use them for commercial fish raising. It is not clear yet whether or not raising these fish will be profitable. According to I. A. Grechanov, IBIW tried to grow carp for sale before, but the carp production cost at the time was 5-10% higher than its sales price. It is impossible and unreasonable to calculate all production costs of raising fish in the present experimental tank system, especially the cost of energy consumed for heating. It is obvious, though, that these costs have to be estimated before the commercial full-scale operation is started. Another factor which should be included in cost accounting is the risk of theft and fish loss from damaged cages.

For a long time, State-funded Russian academic and research institutions such as IBIW were doing contract (Akhozdogovor@) work for various levels of government authorities, enterprises, and other research institutions. This served as an additional source of financing. In the past, these works were considered to be supplemental, as the main focus was on scientific research. At present, as state funding for scientific research shrinks, IBIW needs to increase the share of financing obtained through contract work, which requires a re-orientation from academic to applied work and the active marketing of products and services. The partnership is allowing the IBIW to develop marketing strategies and skills, which will establish a strong basis for the development of IBIW's self-sustainability and will facilitate its integration into the market economy. The fish-raising operation is still in an experimental stage and is not likely to produce much revenue next year when the project ends. If the developments and ideas created by the project are effectively pursued, however, the economic conditions at IBIW and the well-being of its staff should improve.

References:

Kozlov V. I., L.S. Abramovich. Spravochnik rybovoda, 1980.
Moiseev P.A., A.S. Vavilkin, I.I. Kuranova. Ikhtiologiya i rybovodstvo